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SABLEFISH (Anoplopoma fimbria) MIGRATION IN THE GULF OF ALASKA BASED ON GULF-WIDE TAG RECOVERIES, 1973-1981

By

Barry E. Bracken

STATE OF ALASKA
Jay S. Hammond, Governor
DEPARTMENT OF FISH AND GAME
Ronald O. Skoog, Commissioner
P.O. Box 3-2000, Juneau 99802

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Barry E. Bracken
Region I Groundfish Biologist

Alaska Department of Fish and Game
Division of Commercial Fisheries
P.O. Box 667
Petersburg, Alaska 99833

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ABSTRACT

Since the passage of the Magnuson Fisheries Conservation Act of 1976, which establishes a 370 km (200 nmi) fishery zone, fisheries scientists have argued the extent of sablefish *(Anoplopoma fimbria)* movement in the Gulf of Alaska. U.S. and Canadian scientists have claimed sablefish to be non-migratory, while Japanese studies indicate extensive geographical intermingling.

This report describes an analysis of Gulf-wide sablefish tagging data that indicates that sablefish do move extensively throughout the Gulf of Alaska. Fish under 60 cm tend to move westward while fish 60 cm or greater tend to migrate eastward. Over 50% of the fish were recovered over 185 km (100 nmi) from their release site, and the average distance traveled for all fish, was 565 km (305 nmi) per year. Over 46% crossed at least one of the established International North Pacific Fisheries Commission (INPFC) regulatory boundaries before recovery.

A conceptual model is presented that suggests that Southeastern Alaska and British Columbia is a pooling area for large fish and that much of the spawning occurs in that region. Small fish rear in the shallow nearshore areas and then enter deep water in their third or fourth year. From there a significant portion of the fish migrate to open ocean and move westward until they reach maturity. A large portion of the mature fish then migrate back into the Eastern Gulf to spawn.

The report recommends managing sablefish as a single stock Gulf-wide and suggests a conservative management approach to speed rebuilding of the depleted spawning population in the Southeastern area.

INTRODUCTION

Since the passage of the Magnuson Fisheries Conservation Management Act (MFCMA) in 1976 which establishes a 370 km (200 nmi) fishery zone, fisheries scientists have debated whether sablefish *(Anoplopoma fimbria)* in the Gulf of Alaska should be managed as a single stock or as discrete stocks managed by smaller geographic areas. Sablefish are presently managed by regulatory areas composed of the discrete units previously designated as International North Pacific Fisheries Commission (INPFC) statistical areas (Figure 1).

Low et al. (1976) reported that while "There is some evidence that sablefish stocks from California to the Bering Sea may be interrelated...the interchange of sablefish is slow and the majority of these fish are apparently localized and do not migrate over great distances." The report stated that less than 1% of the fish migrated across more than two INPFC areas and more than 50% were recovered within their INPFC area of tagging. Wespestad et al. (1978) analyzed tag returns for the years 1971-1976, including 372 from the Eastern Gulf of Alaska. The authors concluded that sablefish are "basically sedentary with most observed movements short range and random." They stated that for management purposes sablefish can be divided into stock groupings, and that INPFC areas may be suitable for management units. Beamish et al. (1980) reported on recoveries from releases of 37,296 adult and 25,497 juvenile sablefish released in Canadian waters from 1977-1979. The authors concluded that, based on recoveries from their studies, "there is no evidence that blackcod undergo extensive short-term movements." Wespestad (1981) reported that of 969 recoveries of fish tagged through 1980, 65% were recovered within 100 km (185 nmi) of the release site, 24% within 100-500 km (54-270 nmi), and only 11% beyond 500 km (270 nmi) from the release site. He reported a slight correlation between distance traveled and days at large and no correlation between season released or size-at-tagging and distance traveled. As a result of the analysis, it was concluded that sablefish are primarily non-migratory and most movement is limited to relatively short distances. It was further concluded that long distance movement was restricted to a small portion of the population and migration has little effect on abundance. Therefore, according to the report, the sablefish population can be subdivided into discrete management units.

While all of the above mentioned reports recognize the occurrence of long distance migrations, none indicate any pattern to movement and, in fact, refer to sablefish as primarily non-migratory. In contrast, Sasaki (1979 and 1980) stated that 53% of recoveries from fish tagged throughout the Gulf of Alaska in 1978 were recovered in a different INPFC area within 2 years of release. As a result, he concluded that a considerable geographic mixing occurs over a broad range in a short time span. In his 1979 report he concluded that, based on Gulf-wide recoveries, the stock "is considerably mixed and there exists no sufficient grounds for assuming that grouping into certain independent stocks occurs. Thus, it seems reasonable to consider the whole stock as one unit....for management."

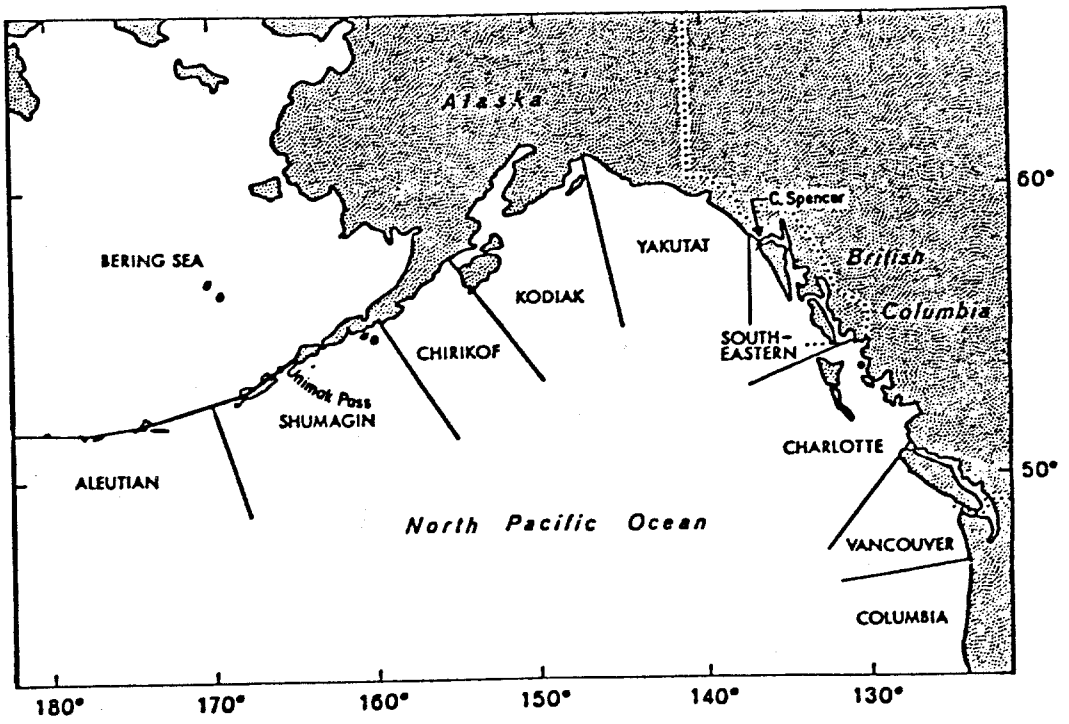


Figure 1. International North Pacific Fisheries Commission (INPFC) areas in the Gulf of Alaska modified from Skud (1977).

Bracken (1981) analyzed tag returns from Alaska Department of Fish and Game (ADF&G) tagging studies near Ketchikan in southern Southeastern Alaska and found evidence of a directional movement by size once the fish reached the open waters of the North Pacific Ocean. It was found that smaller fish tend to move north and westward after leaving Dixon Entrance, while larger fish moved southeastward into British Columbia waters. Smaller fish also tended to move farther from the release site.

Based on findings of the ADF&G tagging study, I decided to analyze additonal tagging data from the Gulf of Alaska to determine if directional movement by size occurred in other areas as well. To accomplish this, I reviewed Japanese tag return data sets from 1973 through August of 1981 and returns from NMFS tagging in Southeastern Alaska from 1971-1981. The results of the analysis are presented in this report. The report also presents a conceptual model for Gulf-wide sablefish migration based on results of the analysis.

METHODS

Japanese technical data reports on recovery of tagged groundfish were used for the analysis as they presented the most comprehensive tagging studies throughout the Gulf of Alaska. Two reports were analyzed. One included returns from 1973 through August 1979 and the other included returns from August 1979 through August 1981. Both include all reported returns of Japanese tags and the returns of other nations' tags by Japanese vessels.

The report data was sorted by length frequency. Distance and direction of travel were calculated using the coordinates given and measuring around the Gulf on approximately the 500 m isobath. Only recoveries which included both release and recapture coordinates, release and recapture dates, and release length were used. All data from fish tagged outside of the Gulf of Alaska was discarded. A total of 213 recoveries had all the information necessary to use in the analysis.

The tag return data was summarized (Appendix Table 1) by 5 cm length frequency group to show: (1) average days at large; (2) average kilometers traveled, both total and adjusted, for year at large; (3) percent and number of recoveries over 185 km (100 nmi) from the release site; (4) percent and number of recoveries that crossed one or more INPFC boundaries from the release area; and (5) the percent of the length frequency group that traveled a predominant direction over 185 km from the release site. It should be noted that because the Gulf of Alaska is semi-circular in shape, use of directions other than east (clockwise) and west (counter-clockwise) would be confusing even though they occur. For example, movement from the Shumagin INPFC area to Kodiak is N.E., and movement from Yakutat to the Charlotte area is S.E., while both represent eastward movement (Figure 1). The data sets were further analyzed to determine the statistical validity of the hypotheses that: (1) direction of migration is related to size of fish at release, and (2) the likelihood of recovery in a given INPFC area is dependent on the size of fish at release.

While not analyzed in such detail, another data set was examined for comparison. A total of 551 National Marine Fisheries Service (NMFS) tag returns

from tagging studies conducted in Southeastern Alaska were analyzed. Fish recaptured less than 1,000 days from the date of release (Appendix Table 2) were analyzed separately from fish at large for 1,000 days or more (Appendix Table 3). This was done because it was apparent from the raw data that fish recaptured after over 1,000 days at large behaved differently than fish recaptured within 1,000 days at large. It should be noted that distance traveled for the NMFS data set was computed by NMFS on straight line travel rather than measured along the most probable route of movement as was done for the Japanese tag recoveries. Because of this, average distance traveled is expected to be somewhat less than computed for the Japanese data sets.

Returns were not adjusted for the probability of a recaptured tag being returned since, with the exception of the Charlotte and Vancouver INPFC areas, return rate is assumed to be fairly uniform throughout the Gulf of Alaska. Sasaki (1980) reports that the return rate of Japanese tags by Japanese fishermen is estimated to be near 30% of those recaptured. This is close to the estimated return rate of Japanese tags by U.S. fishermen fishing in the Southeastern INPFC area. Although the return rate of all tags in British Columbia waters is estimated to be higher, reduction of recoveries from the Charlotte and Vancouver areas does not alter the results of the analysis.

RESULTS

This study indicates directional migration of sablefish throughout the Gulf of Alaska. The majority of tagged fish released from both the ADF&G and Japanese tagging which were recovered over 185 km (100 nmi) at less than 60 cm fork length moved westward and fish 60 cm or longer moved eastward, with the tendency for direction of movement directly proportional to release length (Figures 2 and 3). A chi-square test of independence of length and direction of movement was very highly significant ($P < 0.005$).

Japanese Data

The average distance traveled for all recovered fish from the Gulf of Alaska tagging was 678 km (366 nmi) from the release site. Figure 4 demonstrates the distance traveled adjusted for 1 year at large to show the extent of short term movement. The 70-74 cm length group moved the farthest 864 km (466 nmi) and the 55-59 cm group moved the least 232 km (125 nmi).

The percent of all recoveries which were made over 185 km (100 nmi) from the release site by 5 cm length groups are shown in Figure 5. The large fish traveled further than the smaller fish and slightly over 50% of all tagged fish recovered traveled over 185 km. Forty-six percent crossed at least one INPFC boundary and, again, there was a tendency for the larger fish to travel further (Figure 6). It was considered appropriate to use 185 kilometers or 100 nautical miles as an indicator of significant movement since most fish were recovered either over 1,000 km (540 nmi) or less than 100 km (54 nmi) from the release site. Figure 7 shows that this trend applies to both fish under 60 cm and 60 cm or greater. The group of fish under 60 cm had a high percentage of the total recoveries within 93 km (50 nmi) of the release site, while in the group of fish 60 cm and larger nearly one-third were recovered over 927 km (500 nmi) from the release site.

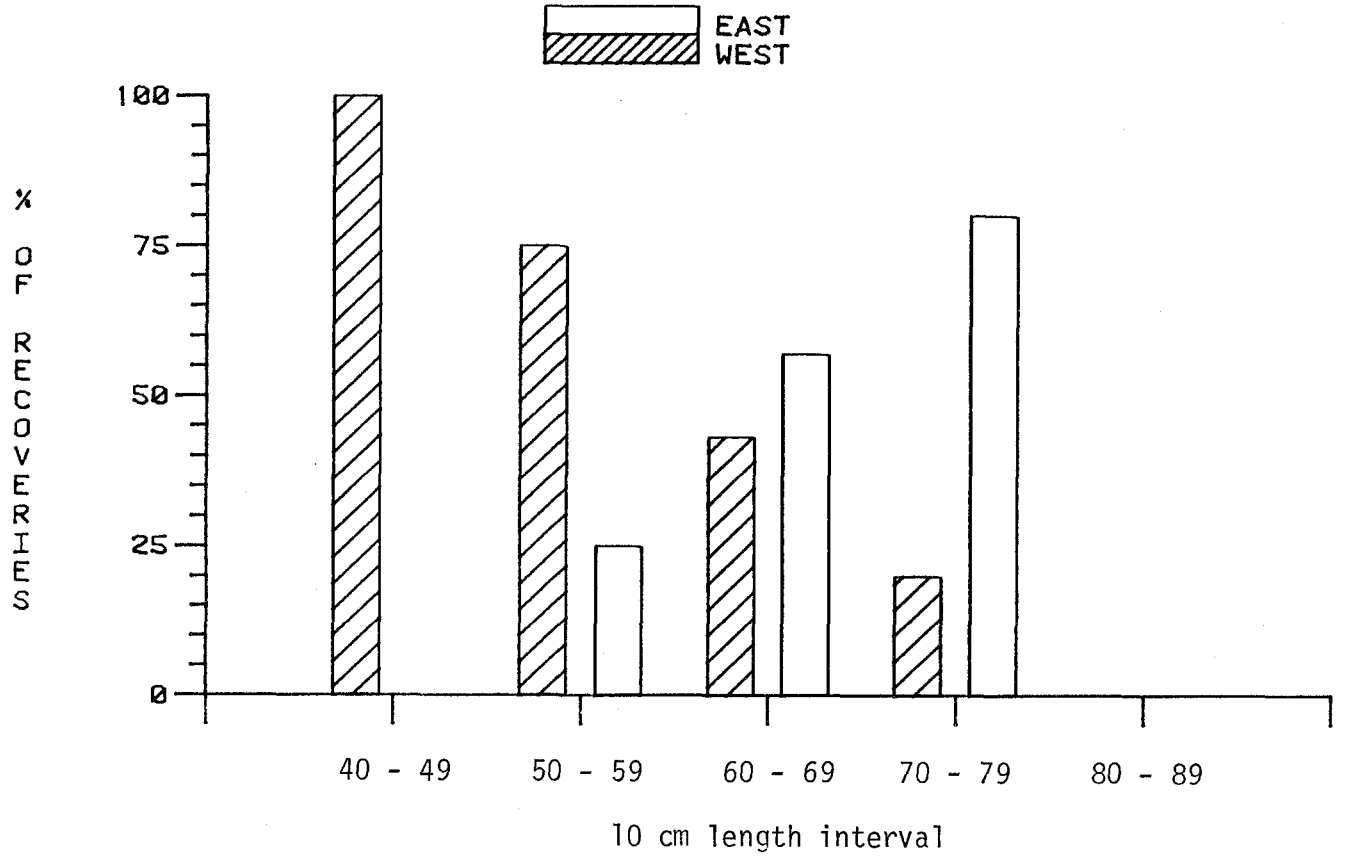


Figure 2. Direction of movement by 10 cm length group of sablefish that were tagged (Alaska Department of Fish and Game in the Ketchikan area of Southeastern Alaska, 1979-1981) and recovered over 185 km (100 nmi) from release site.

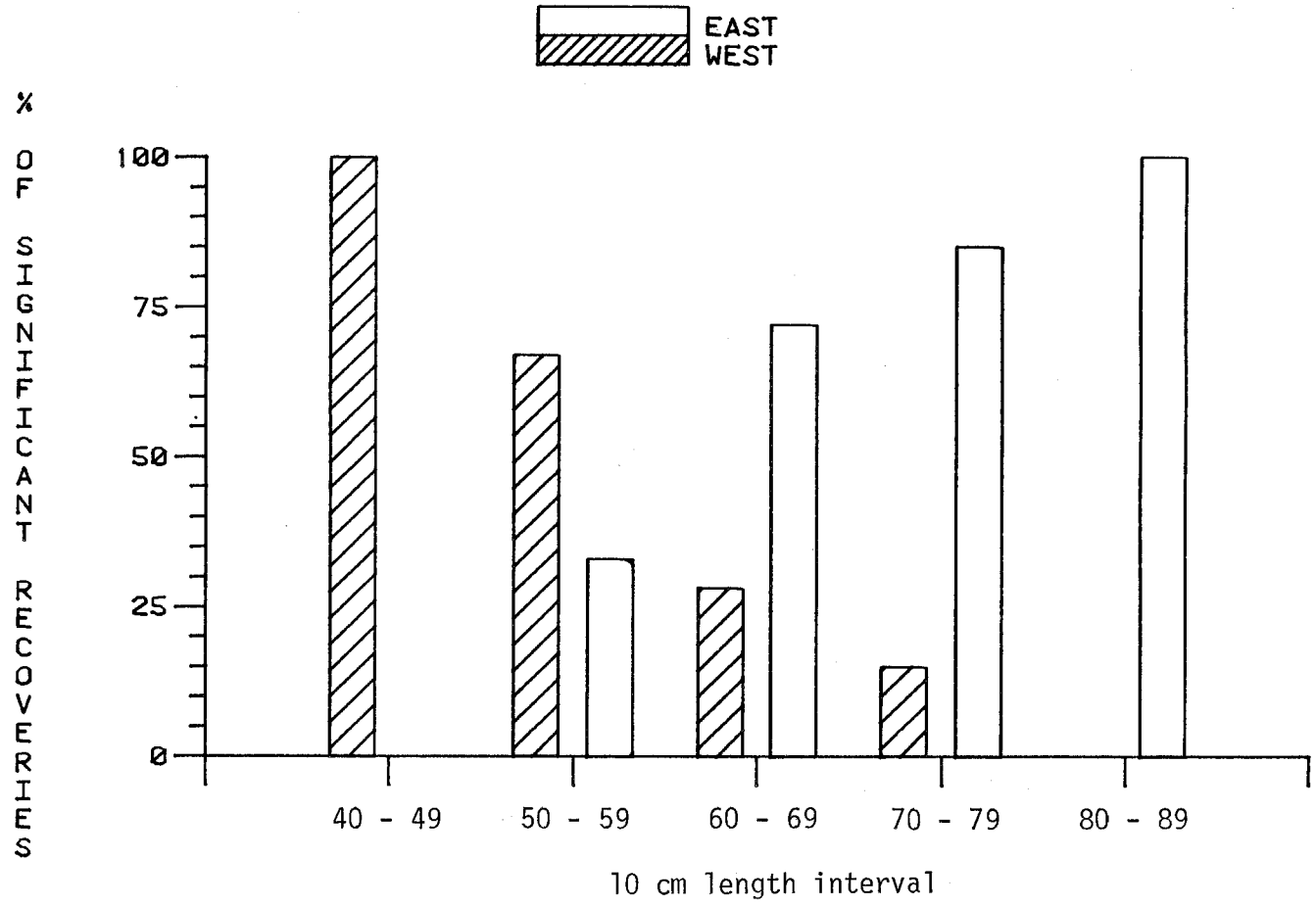


Figure 3. Direction of movement by 10 cm length group of sablefish that were tagged in the Gulf of Alaska and recovered over 185 km (100 nmi) from release site from Japanese data, 1973-1981.

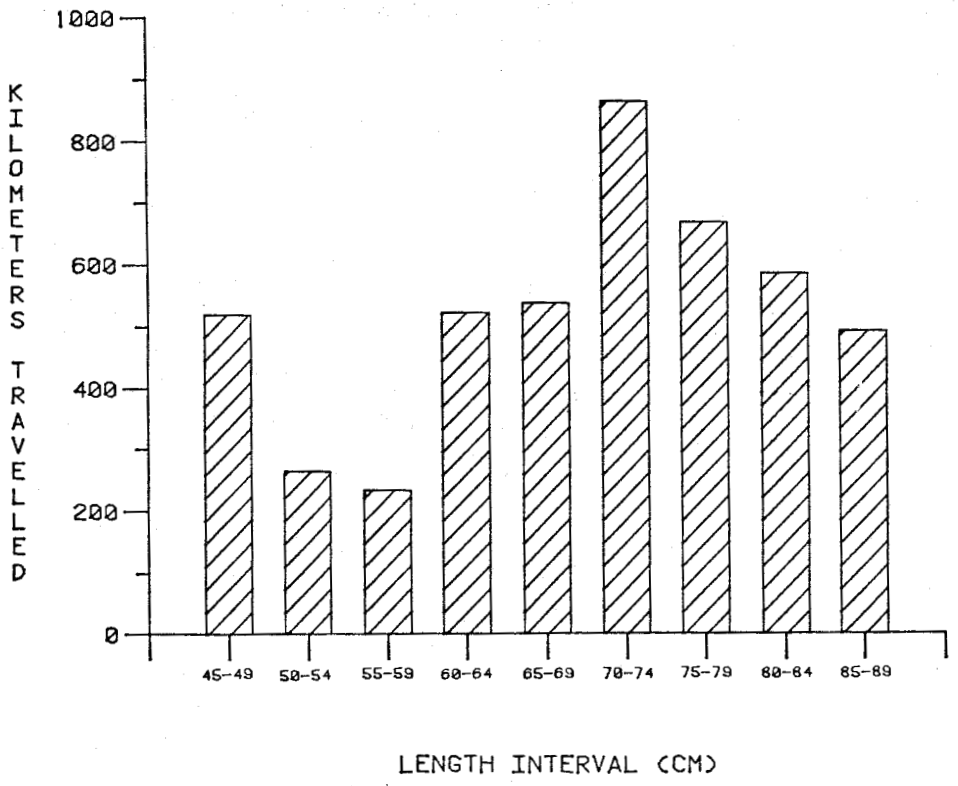


Figure 4. Average distance traveled by 5 cm length group of sablefish tagged in the Gulf of Alaska standardized to one year at large.

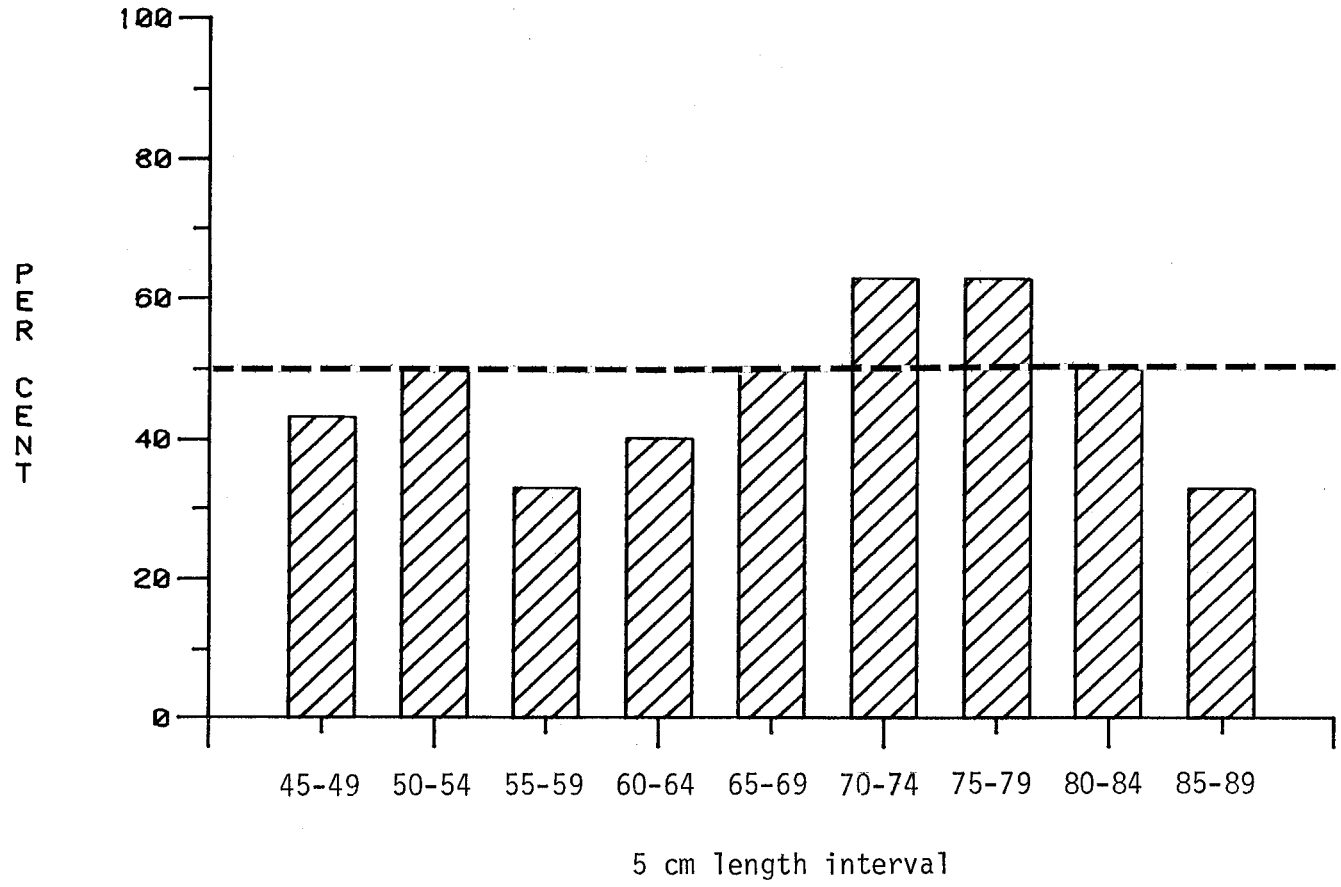


Figure 5. Percent of each 5 cm length group of sablefish that were recovered over 185 km (100 nmi) from the release site from tagging studies in the Gulf of Alaska, 1973-1981.

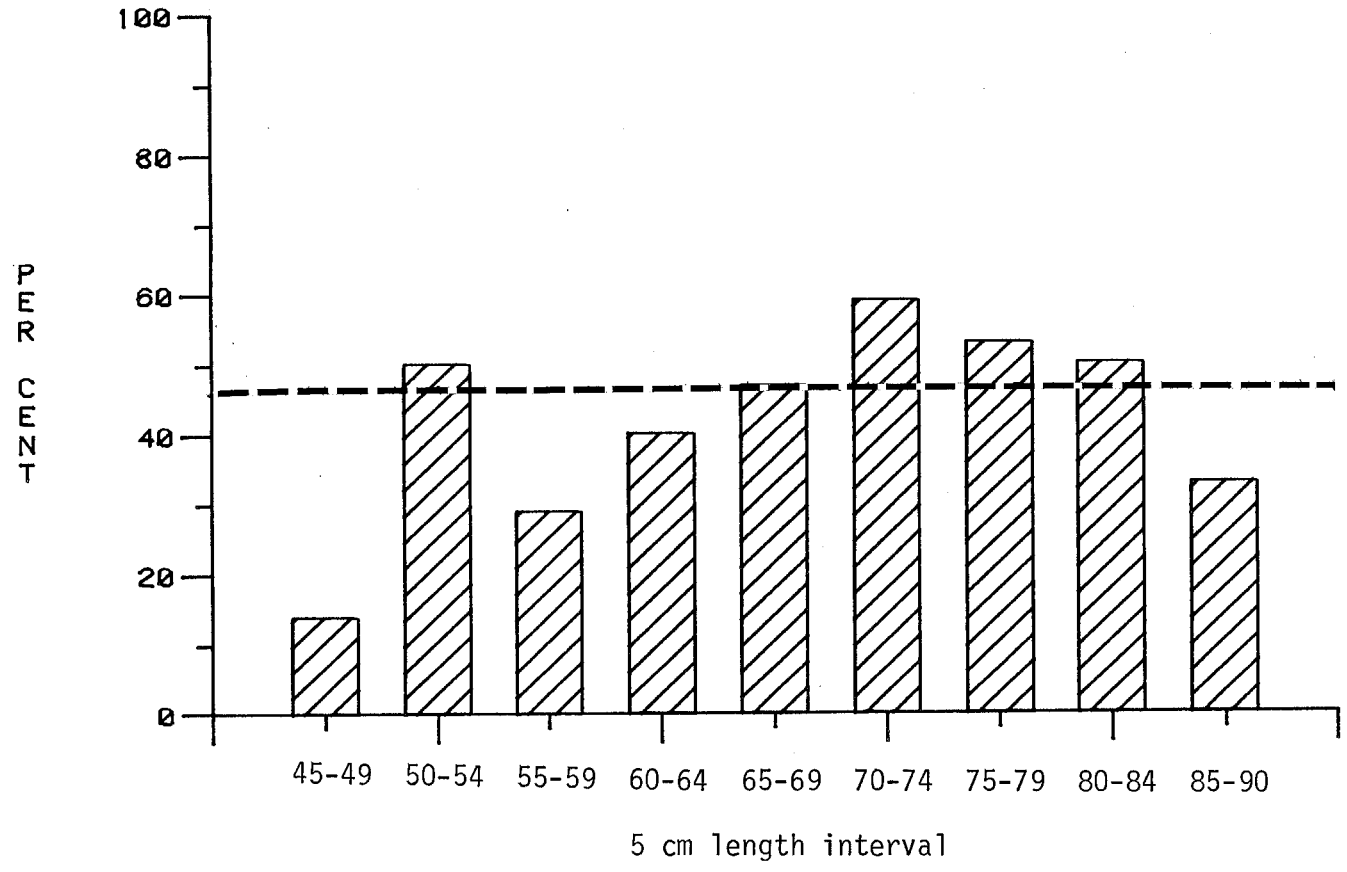
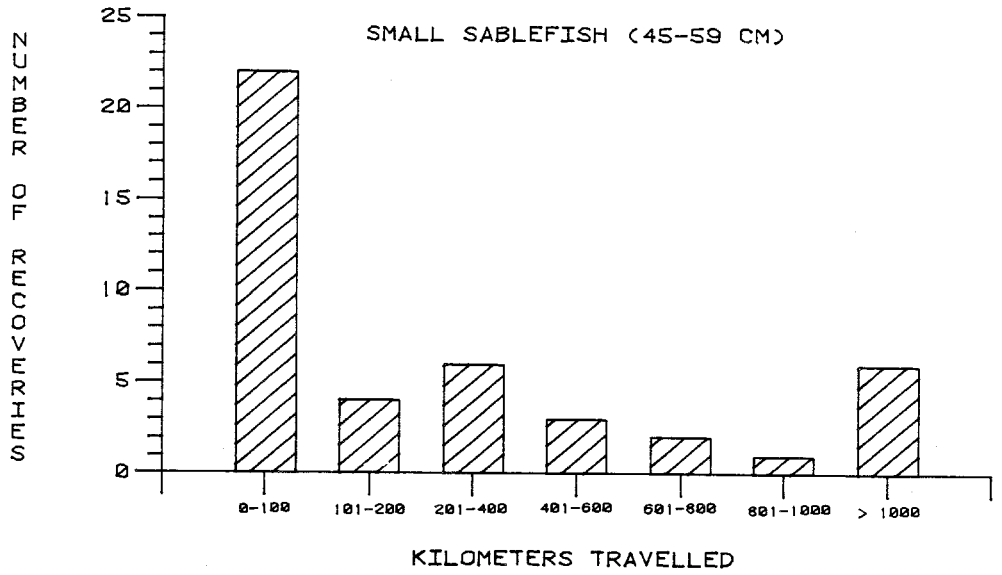


Figure 6. Percent of each 5 cm length group of sablefish that were recovered at least one INPFC area away from the release site from tagging studies in the Gulf of Alaska, 1973-1981.



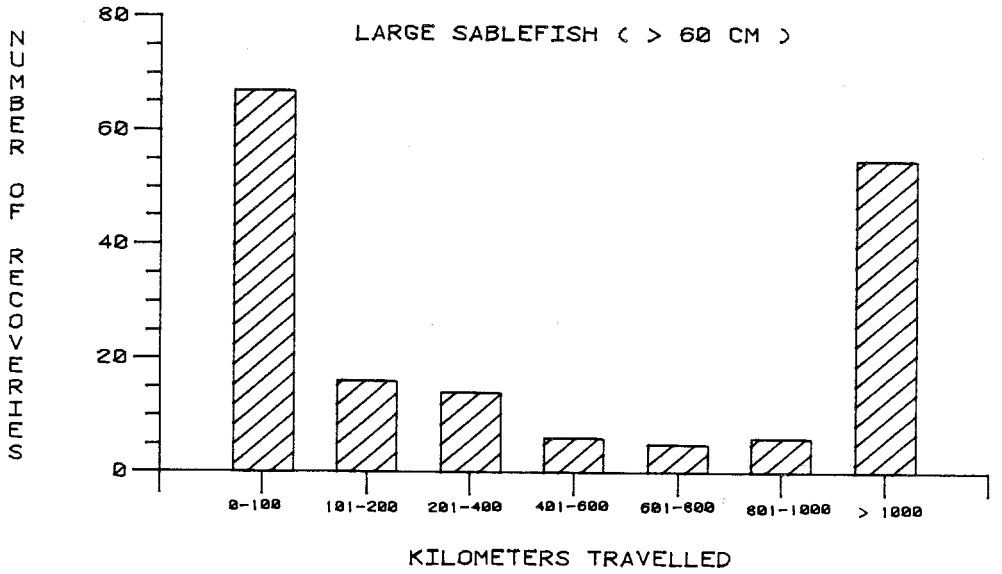


Figure 7. Distance traveled from release site by size group for sablefish tagging in the Gulf of Alaska, 1973-1981.

To help explain why there is a tendency for either very little movement or substantial movement, a table showing INPFC area of tagging and release by length frequency group is presented (Table 1). The table shows that more of the larger fish are recovered in the Southeastern Alaska and British Columbia (Charlotte and Vancouver INPFC areas) region indicating that this region is a pooling area for larger fish. Slightly over 55% of all recovered large fish that were tagged in the Aleutian, Shumagin, and Chirikof areas were recovered in the Southeastern, Charlotte, or Vancouver areas.

This trend is graphically displayed in Figure 8 which shows a descending trend of percent recovery of fish over 60 cm in the INPFC area of release from east to west and a descending trend of percent recovery of fish less than 60 cm from west to east. A chi-square test for independence of size at tagging and number of recoveries in an INPFC area that were tagged in that INPFC area is highly significant ($P < 0.005$). To conduct the test, recoveries in the Aleutian and Shumagin (Western Gulf) areas were pooled, as were the recoveries in the Chirikof and Kodiak (Central Gulf) areas, because of the small sample size in the Aleutian and Chirikof areas.

Table 2 shows that 86% of the fish over 60 cm that were tagged in the Southeastern INPFC area were recovered in that area compared to 55% of the fish under 60 cm. In the more western Shumagin INPFC area only 24% of the fish over 60 cm that were tagged in that area were recovered in that area compared to 86% of the fish tagged at less than 60 cm.

Table 2 also shows that fish over 60 cm tagged in the Central and Western Gulf have a much greater probability of being recovered two or more INPFC areas from the area of release. Most fish tagged at less than 60 cm were recovered within the same or within one INPFC area of the area of release. That seems to indicate that movement of large fish eastward is more rapid and directed than is the westward movement of smaller fish.

NMFS Data

Although the NMFS data was not analyzed in such detail, it shows similar trends. Fish at large less than 1,000 days (Appendix Table 2) and less than 60 cm traveled predominantly westward and fish 60 cm or greater traveled predominantly eastward. A chi-square test of the independence of fish length and direction of movement is very highly significant ($P < .005$). The smallest fish tended to be the most migratory.

Fish recaptured over 1,000 days after release behaved differently. In this group 94% of all significant migrations were south or eastward, regardless of size, and 51% crossed at least one INPFC boundary (Appendix Table 3). Only 5 fish were recaptured over 185 km (100 nmi) westward of the release site. The percent of migrations over 185 km decreased with fish size as did the percent of fish which crossed at least one INPFC area. Although the sample size is smaller it should be noted that fish over 70 cm showed very little movement compared to smaller fish.

Table 1. INPFC area of release and recapture by length group for sablefish tagged in the Gulf of Alaska, 1973-1981.

AREA OF TAGGING	INPFC AREA OF RECOVERY																	
	Vancouver		Charlotte		Southeast		Yakutat		Kodiak		Chirikof		Shumagin		Aleutian		Totals	
	< 60 cm	60 > cm	< 60 cm	60 > cm	< 60 cm	60 > cm	< 60 cm	60 > cm	< 60 cm	60 > cm	< 60 cm	60 > cm	< 60 cm	60 > cm	< 60 cm	60 > cm	< 60 cm	60 > cm
Southeast	-	2	2	2	6	49	2	1	-	1	1	2	-	-	-	-	11	57
Yakutat	-	2	-	4	-	6	3	11	2	3	1	2	-	-	-	-	6	28
Kodiak	-	3	-	8	-	4	-	2	7	11	1	2	3	-	-	-	11	30
Chirikof	-	3	-	5	-	2	-	1	1	1	5	3	2	-	-	-	8	15
Shumagin	-	3	-	4	-	8	-	1	-	3	1	3	6	7	-	-	7	29
Aleutian	-	-	-	1	-	1	-	-	-	-	-	1	-	-	1	2	1	5
Total	-	13	2	27	6	70	5	16	10	19	9	13	9	7	1	2	44	164

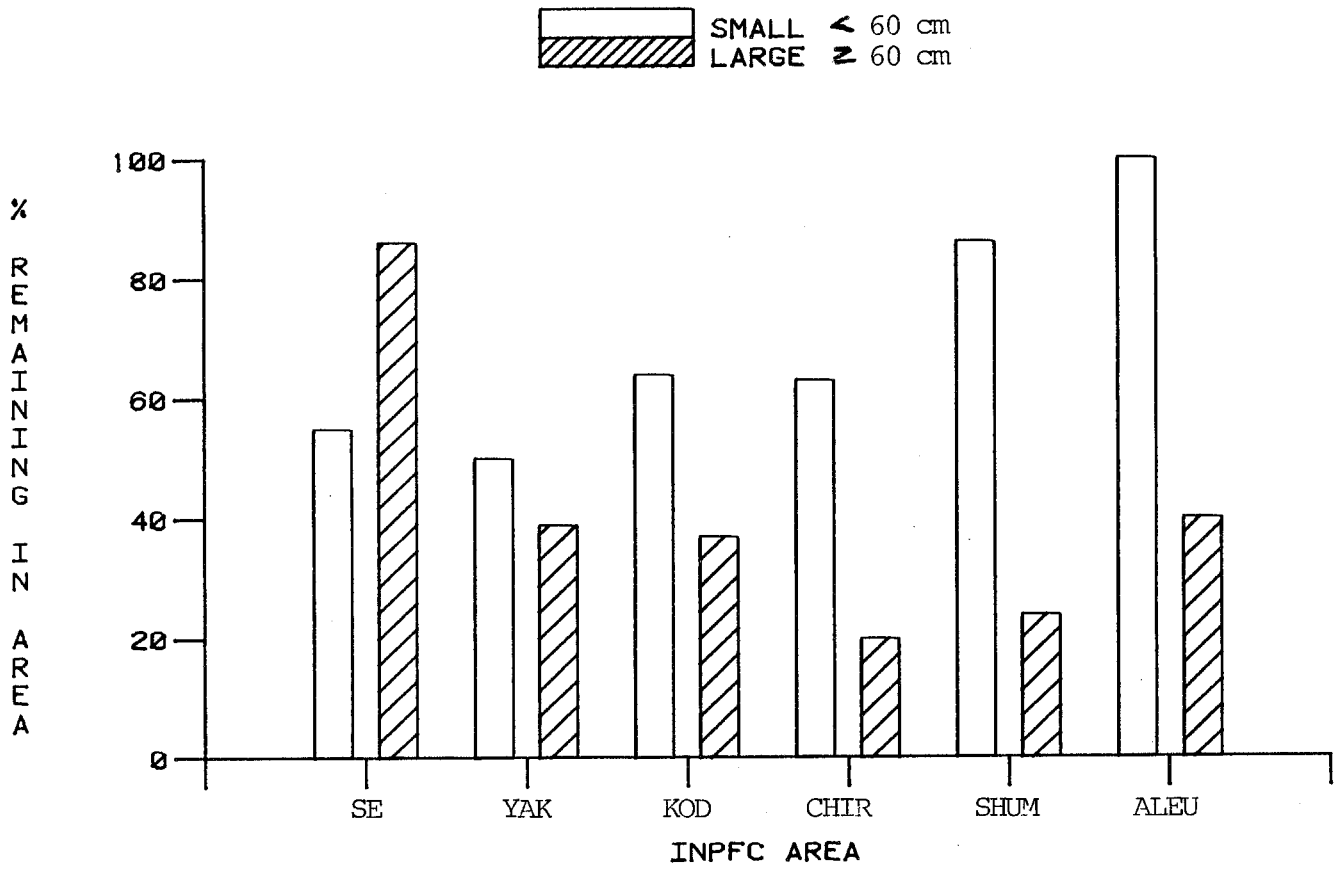


Figure 8. Percent of sablefish recovered in the INPFC area of tagging by size group from sablefish tagging experiments in the Gulf of Alaska, 1973-1981.

Table 2. Number and percent of sablefish recaptured in the same INPFC area, one INPFC area away, and more than one INPFC area away from the tagging site. From Japanese tagging studies in the Gulf of Alaska, 1973-1981.

INPFC area	Fish recovered in the same INPFC area		Fish recovered one INPFC area from release		Fish recovered more than one INPFC area from release		Total	
	<60cm	60> cm	<60cm	60> cm	<60cm	60> cm	<60cm	60> cm
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Southeast	6(55)	49(86)	4(36)	3(5)	1(9)	5(9)	11(100)	57(100)
Yakutat	3(50)	11(39)	2(33)	9(32)	1(17)	8(29)	6(100)	28(100)
Kodiak	7(64)	11(37)	1(9)	4(13)	3(27)	15(50)	11(100)	30(100)
Chirikof	5(63)	3(20)	3(38)	1(7)	0	11(73)	8(100)	15(100)
Shumagin	6(86)	7(24)	1(14)	3(10)	0	19(66)	7(100)	29(100)
Aleutian	1(100)	2(40)	0	0	0	3(60)	1(100)	5(100)
Total	28(64)	83(51)	11(25)	20(12)	5(11)	61(37)	44(100)	164(100)

DISCUSSION

This study shows extensive directional movement of both mature and juvenile sablefish in the Gulf of Alaska. Sablefish tagged throughout the Gulf moved an average of 565 km (305 nmi) in 1 year from the time of release. Over 50% were recovered over 185 km (100 nmi) from the release site, and 46% crossed at least one INPFC boundary. These results lead to the conclusion that sablefish are highly migratory and should be managed as a single stock Gulf-wide. Of possibly even more importance is the fact that distribution of distance traveled is bimodal, with most of the large fish traveling either less than 100 km (54 nmi) or more than 1,000 km (540 nmi) from the release site. Furthermore, extent of movement is dependent on fish size and the area of tagging. Large fish tagged in the Southeastern INPFC area had a much higher probability of being recaptured in that area than did the small fish. That trend was reversed in the Western Gulf. The Central Gulf areas retained a slightly higher percentage of small fish than large fish, but the difference was not nearly so pronounced.

These results suggest a directed migration between the Eastern Gulf and the Western Gulf rather than a random distribution of fish throughout the Gulf. Of the recovered fish analyzed in this study, more large fish were recovered in the Eastern Gulf than were tagged in that area, while in the Western Gulf more small fish were recovered than were tagged. Pooling of large fish in the Vancouver, Charlotte, and Southeastern INPFC areas is evident in Table 1. Over 55% of the recovered fish 60 cm or larger tagged in the Aleutian, Shumagin, or Chirikof INPFC areas were recovered in the Southeastern, Charlotte, or Vancouver INPFC areas. The contention that the Eastern Gulf is a major spawning ground is supported by the literature. Sasaki (1979) states, "This area is a very important fishing ground with the highest productivity within the northeastern Pacific...". Balsiger (1981) presents a table showing that fish in the Yakutat and Southeastern INPFC areas averaged 2 cm longer than in the Shumagin area and at least 3 cm longer than in the Kodiak and Chirikof areas between 1969 and 1978.

This may also explain why prior analysis of NMFS and Canadian tagging experiments on mature fish in the Eastern Gulf failed to demonstrate extensive movement. Appendix Tables 2 and 3, which present the analysis of NMFS tag returns, show that while the migration rate is substantially less for fish tagged in the Southeastern area, directional movement by size group is still evident; an average of 20% of the fish recaptured within 1,000 days of release crossed at least one INPFC boundary in a little over 1 year. That is a much higher exchange rate between the INPFC areas than for halibut, which are considered to be highly migratory. Movement of juvenile halibut from the Western and Central Gulf into the Eastern Gulf over a 13-year period averaged only 2.1% per year (Skud 1977).

Results of the NMFS data analysis complement and support the analysis of the Japanese data. The lesser movement of large fish supports the concept of the Eastern Gulf as a pooling area for large fish. The fact that fish at large over 1,000 days tend to move eastward regardless of size while small fish recaptured after less than 1,000 days at large move westward suggests that the direction of migration reverses at some intermediate size. The direction of migration is assumed to be a function of maturity rather than size and thus would be expected to vary by sex.

A CONCEPTUAL MODEL OF SABLEFISH MOVEMENT

Data presented in this paper suggests a directed rather than random pattern of sablefish migration. With that assumption in mind, I will present a theoretical model to, perhaps, explain movement of sablefish throughout the Gulf of Alaska.

Evidence indicates that the Eastern Gulf of Alaska including the Charlotte, Southeastern, and at least part of the Yakutat INPFC areas, contains the major spawning grounds for the Gulf-wide sablefish population. Specific areas of spawning are probably situated such that eggs and larvae drift north and eastward toward shore with the prevailing currents. Passive current drift of eggs and larvae, and the location of spawning grounds to favor appropriate drift of eggs and larvae into productive rearing areas, has been demonstrated for several other species including halibut (Skud 1977).

Juvenile sablefish rear in the shallow, nearshore bays, and coastal fjords until their third or fourth year, at which time they are 45-50 cm in length (Bracken 1981) and then move into adjacent deep water areas. As a result of competition or some other mechanism, a significant portion of the young fish then migrate to the open ocean. Often that migration is against the prevailing current. Once the juvenile fish reach the open ocean they move westward, with the smaller length frequency groups traveling the farthest. Whether that movement is directed or a result of movement with current flow is not known. Current flow along the shelf is as fast as 10 knots or 5.14 m/s (Skud 1977), which could result in extensive non-directed movement. The fact that most small fish were recovered within one INPFC area of the release site (Table 2) indicates a progressive movement over time rather than a rapid directed migration to the Western Gulf.

Length and age at maturity by sex from NMFS and ADF&G sampling is presented in Table 3. The length when 90% of the fish are expected to be mature corresponds very closely to the length at which the predominant direction of movement shifts from westward to eastward (60 cm). Eastward migration as a function of maturity could explain why a gradual shift of direction of movement is evident for fish between 50 and 80 cm in the Japanese, ADF&G, and NMFS tags recovered within 1,000 days after release. Because of the extent of counter-current movement observed for larger fish, it appears that eastward movement can be considered true migration rather than compensatory emigration. The data indicates that when maturity is reached the fish move directly back to the Eastern Gulf for spawning where the cycle repeats itself. Since fish with ripe ova have been reported throughout the Gulf (Low 1976) there may be migratory and non-migratory components to the Gulf-wide stock.

CONCLUSIONS

Although the conceptual model for Gulf-wide movement is speculative, the extent of geographic intermixing is not. Based on the results of this analysis,

Table 3. Age and length at maturity for male and female sablefish in the Gulf of Alaska.

	50% Maturity		90% Maturity		100% Maturity	
Sex	Age	Length (cm)	Age	Length (cm)	Age	Length (cm)
Females	7	58	9	66	11-12	72
Males	5	50	9	59	15	72

the ADF&G tagging studies and indications from earlier studies on sablefish, there is substantial evidence suggesting that the Gulf of Alaska sablefish should be considered a single stock for fisheries management. Thus, if one component of the stock shows signs of distress, i.e., the reduction in availability of spawning fish in the Southeastern INPFC area (Zenger 1981) it is an indication of the need for conservative management Gulf-wide until the spawning population rebuilds to historic levels.

Extensive fishing in the Charlotte and Vancouver INPFC areas during the past 2 years results in catches in excess of 3,500 mt annually (personal cummication, Al Cass, Canadian Department of Fisheries and Oceans, Nanaimo). Continued fishing on spawning stocks in those areas, coupled with continued high harvest levels on maturing fish in the Central and Western Gulf, will undoubtedly slow the rebuilding rate in the Southeastern area.

The increase in abundance of small fish during the past 3 years in many areas of the Gulf (Sasaki 1981; Zenger 1981) is encouraging and an indication that stocks are beginning to rebuild after extensive overexploitation during the late 1960's to mid-1970's. However, until the spawning population in the Eastern Gulf shows definite signs of rebuilding, the Gulf-wide harvest should be reduced to promote rebuilding as quickly as possible.

I recommend that analysis of all future recoveries include a study of directional travel by fish size and time at large. Also, an analysis of movement by sex should be considered. Specific tagging studies may be needed to fill the existing data gaps.

ACKNOWLEDGMENTS

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I would like to acknowledge Alaska Department of Fish and Game staff members Jim Eastwood for his assistance in summarizing the raw data, Fritz Funk for assistance with the statistical analysis and computer graphics, and Rexanne Stafford for the clerical support.

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I do, however, assume full responsibility for the content and conclusions.

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APPENDICES

Appendix Table 1. Summary of Japanese recoveries of sablefish tagged in the Gulf of Alaska, 1973-1981.

Release length (cm)	No. in group	Average days at large	Average km traveled		Migrations over 185 km (100 nmi)		Migrations over at least one INPFC boundary		Direction of movement over 185 km	
			Total	Per year	%	No.	%	No.	%	Direction
45 - 49	7	327	463	517	43	3	14	1	100	W
50 - 54	16	580	423	265	50	8	50	8	75	W
55 - 59	21	368	235	232	33	7	29	6	57	W
60 - 64	35	421	602	523	40	14	40	14	57	E
65 - 69	58	417	615	537	50	29	47	27	79	E
70 - 74	46	432	1,023	864	63	29	59	27	90	E
75 - 79	19	450	823	667	63	12	53	10	75	E
80 - 84	8	567	904	582	50	4	50	4	100	E
85 - 89	3	729	980	489	33	1	33	1	100	E
Total	213	438	678	565	50	107	46	98	-	-

Appendix Table 2. Summary of recoveries within 1,000 days of release from National Marine Fisheries Service (NMFS) sablefish tagging studies in Southeastern Alaska, 1971-1981.

Release length (cm)	No. in group	Average days at large	Average km traveled		Migrations over 185 km (100 nmi)		Migrations over at least one INPFC boundary		Direction of movement over 185 km	
			Total	Per year	%	No.	%	No.	%	Direction
45 - 49	8	189	417	806	75	6	75	6	100	W
50 - 54	25	420	265	230	32	8	32	8	89	W
55 - 59	48	432	115	96	15	7	15	7	57	W
60 - 64	127	376	185	180	25	32	16	20	53	E
65 - 69	109	374	191	187	28	31	20	22	55	E
70 - 74	54	401	224	204	22	12	24	13	83	E
75 - 79	25	404	115	104	12	3	16	4	100	E
80 - 84	7	232	293	461	29	2	29	2	50	E-W Split
85 - 89	3	506	17	13	0	0	0	0	-	-
Total	406	385	189	180	25	101	20	82	-	-

Appendix Table 3. Summary of recoveries of fish at large over 1,000 days from National Marine Fisheries Service (NMFS) sablefish tagging studies in Southeastern Alaska, 1971-1981.

Release length (cm)	No. in group	Average days at large	Average km traveled		Migrations over 185 km (100 nmi)		Migrations over at least one INPFC boundary		Direction movement over 185 km	
			Total	Per year	%	No.	%	No.	%	Direction
40 - 44	1	1,369	282	75	100	1	100	1	100	E
45 - 49	3	1,898	610	117	67	2	67	2	100	E
50 - 54	21	2,147	680	116	71	15	62	13	93	E
55 - 59	37	2,059	586	104	65	24	59	22	96	E
60 - 64	47	1,935	452	85	57	27	47	22	96	E
65 - 69	22	1,858	608	120	54	12	50	11	83	E
70 - 74	10	1,949	116	22	11	1	22	2	100	E
75 - 79	2	3,008	501	61	50	1	50	1	100	E
80 - 84	2	1,413	56	14	0	0	0	0	0	-
85 - 89	-	-	-	-	-	-	-	-	-	-
Total	145	1,990	517	95	57	83	51	74	94	E